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論　文　内　容　の　要　旨
Abstract of Dissertation

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In this study, the author experimentally investigated the transfer and interaction of charged particles from an alternating current glow discharge on the liquids and the ability of this process to synthesize noble metal nanoparticles. The mechanism of the interaction and transfer of species from the plasma on liquids has been studied. These works are based on the investigation only on each species or charged particle at the plasma-liquid interface. To understand the synthesize noble metal nanoparticles, the effect of the oppositely charged particles should be confirmed alternate impact and synthesize it on a liquid.

To achieve these goals, we have investigated using an experimental apparatus that generate AC glow discharge on liquids. The change of the chemical compositions in the liquids was observed to study the effect of AC glow discharge on the liquid. The process was monitored via the measurement of pH and electrical conductivity. The results showed that AC glow discharge acidifies the solutions of neutral or base, and alkalizes the solutions of nitrate salt. The results indicated that AC glow discharge alternately generates both positive ions and free electrons. The interaction of positive ions from AC glow discharge with water molecules leads to the generation of OH radicals and hydronium cation H_3O^+. Free electrons from AC glow discharge transfer and absorb into the liquid to form solvated electrons.

The ability in the nano-synthesis of AC glow discharge was also investigated. The results showed that gold and silver nanoparticles were successfully synthesized by AC glow discharge on the precursor solution. The process of the nano-synthesis by AC glow discharge is based on the reduction reactions between solvated electrons and metallic ions. The results also indicated that the pH value in the precursor solutions affects the morphology of gold nanoparticles. At a low pH level, solvated electrons are captured by the available of H_3O^+ instead of reacting with metallic ions, and hence results in a small the size of gold nanoparticles. At a high pH level, there is the change in the form of gold ions and therefore leads to a decrease in the redox potential of the reaction e_{aq} and gold ions.

The synthesis of platinum and copper nanoparticles by AC glow discharge was also monitored. The results showed that it is possible to synthesize platinum nanoparticles in small yield. Meanwhile, there were not copper nanoparticles synthesized during the discharge. Solvated electrons play the main role in reducing species to reduce these ions to neutral atoms. In contrast, OH radicals oxidize copper ions and platinum ions back to a higher oxidized value. The role of redox potential E^0 in the synthesis of noble nanoparticles

was also clarified. At low redox potential, the reaction of e_{aq} and metal ions occurs at a low equilibrium constant. The concentration of neutral atoms generated hence is not enough to reach a supersaturation for the nucleation process. In contrast, the neutral atoms generated in the reaction at high equilibrium constant are sufficient for the existence of the process of nucleation and subsequent growth.

Our findings broaden new understandings of the plasma-liquid interactions. The results indicate that it is possible to use AC glow discharge to synthesize silver, gold nanoparticles. This also suggests a new way to control the morphology of noble nanoparticles via the control of the frequency of the AC power supply. It is an advantage in the nanofabrication because no substance needs to add to the precursor.